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ABSTRACT

This experiment investigated the assumption that children's learning and retention of prose material can be differentially affected by varying discrepancy from expectation (as established by an advance organizer). It was hypothesized that a passage which differed significantly from expectation would produce heightened arousal, which should in turn facilitate long- and short-term retention as measured by fact-inference comprehension measures. Furthermore, intermediate levels of discrepancy should produce better learning and retention than either the control or the completely discrepant extremes. From the data obtained, it was found that there was no significant effect on comprehension and retention due to passage condition. The retention interval effect indicated that forgetting took place. There was also a significant interaction between comprehension type (literal versus inferential) and retention, suggesting that the learning characterized by one type of question was retained to a greater extent than that characterized by the other, or that probably the original learning of material relevant to one question type was greater than that for the other type. (Author/SW)

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Technical Report No. 259

CHILDREN'S PROCESSING OF PROSE: MEMORY FACILITATION BY EXPECTATION AND UNCERTAINTY IN TEXT

by

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Report from the Operations and Processes
of Learning Component of Program 1

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Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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Abstract

The purpose of this experiment was to investigate the assumption that children's learning and retention of prose material can be differentially affected by varying discrepancy from expectation (as established by an advance organizer). It was hypothesized that a passage which significantly differed from expectation would produce heightened arousal, which should in turn facilitate long- and short-term retention as measured by fact-inference comprehension measures. Furthermore, intermediate levels of discrepancy should produce better learning and retention than either the control or the completely discrepant extremes.

From the data obtained, it was found that there was no significant effect on comprehension and retention due to passage condition. The retention interval effect was significant ($p < .0001$), indicating that forgetting took place. There was also a significant ($p < .003$) interaction between comprehension type (literal versus inferential) and retention, suggesting that the learning characterized by one type of question was retained to a greater extent than the other, or that probably the original learning of material relevant to one question type was greater than that for the other type.

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I
Introduction

The experimental study of the learning and retention of prose is in its infancy (Rothkopf & Johnson, 1972). Dixon and Horton (1968) indicate that verbal learning and verbal behavior researchers are increasingly concerned with the study of verbal behavior more complex than that found in tasks such as paired-associate, serial, and free-recall learning. Such laboratory-type tasks not only lack significant theoretical relevance but their implications both in theory and application to the problems of school learning have been seriously questioned (Ausubel, 1968). Much of the experimental research with prose or prose-like contexts has focused on sentential acquisition and processing (Slamecka, 1967) or on highly structured (artificial) prose passages, i.e., passages consisting of series of logical statements (Frase, 1969) or highly organized series of inferences (Rothkopf, 1972).

Another approach to the experimental analysis of prose learning that has been contrasted to the highly structured laboratory method mentioned above is that of using "naturally occurring" passages of the type typically found in children's readers (Farley, in preparation [b]). Here the approach is to experimentally manipulate such things as instructional set, adjunct questions, presence or absence of advance organizers of one sort or another, pacing, and so on in an attempt to facilitate learning and comprehension of such "realistic" material. This may suggest improvements for the development of children's reading materials as well as contribute to the development of theories of learning and comprehension.

One variable that has recently been investigated in relation to prose learning and retention is that of arousal (Farley & Eischens, 1971). A considerable amount of evidence indicates that physiological arousal is an important contributor to verbal learning and memory (Farley, 1972). It is generally shown that in list-learning paradigms arousal is differentially related to short- versus long-term retention, such that high arousal during learning leads to poor short-term but superior long-term retention when compared to the effects of low arousal during learning. Arousal therefore seems to be differentially involved in the processes of short- versus long-term memory. Where prose learning is concerned, the results have been rather more complex. Based on the hypothesis that adjunct questions in text would have arousal-attention effects, Farley and Eischens (1971) studied such adjunct questions in relation to short- versus long-term retention in elementary-school children. The results indicated that questions generally facilitated both short- and long-term retention. Later research using single inserted high- and low-arousal words indicated facilitation of long-term retention of literal or inferential comprehension with slight or no effects on short-term retention (Farley & Schmuller, 1972). The use of long-term retention measures is strongly indicated by this work.

Another approach to the study of arousal effects in prose has been through the manipulation of expectation and uncertainty.

> If a reader is led to expect certain things to occur in the text, certain information to be presented, a certain organization and sequencing of text to take place, then it might be hypothesized that deviations from confirmation of this expectation would be arousing, and would therefore be expected to facilitate long-term retention. . . . On an hypothesis of an inverted-U shaped relationship between arousal and discrepancy, it would be expected that an intermediate degree of discrepancy as compared to no discrepancy, or a very slight discrepancy and a very marked discrepancy would be most arousing and thus most significantly facilitate long-term retention. [Farley, in preparation (a)].

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Evidence for such an inverted-U hypothesis in other contexts has been provided by Berlyne (1960). To study expectation and uncertainty effects in prose, Farley (in preparation [a]) employed an advance organizer followed, depending on the experimental condition, by a narrative passage varying in the degree to which it seemed to follow from or agree with the advance organizer. The latter manipulation was produced by varying the degree of randomness of organization of the passage. Thus the passage could be either completely random (all sentences random with regard to each other) or not at all random, with varying degrees in between. The experimental design called for all Ss to receive the same advance organizer, and then be randomly assigned to the various experimental conditions. It was expected that intermediate discrepancies from expectation (as established by the advance organizer) would be optimally arousing and lead to more active processing of the prose and thus better learning than the other conditions. One problem in this study was the lack of any specifically logical structure to the passage which was a descriptive narrative of the activities and features of a mythical primitive tribe. Thus it is possible that no or relatively small effects of different methods of passage organization would be found. That is, many different (passage) structural organizations might equally well present the description of tribal activities.

The present study was undertaken as an extension of the foregoing organizational experiment. An attempt was made to bring the formal structural properties of the passage under better control. Most work in prose learning has involved learning from printed text or pictorial material, although much of children's learning is from aural discourse; therefore, auditory presentation of the material was used in this experiment. Such presentation would be expected to enhance any uncertainty or discrepancy effects since the child is not able to visually compare previous with present information so as to reduce the uncertainty. Thus the only comparator available to the S is memory, which is the hypothesized target of the arousal manipulation.

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II
Method

Subjects

Two hundred and sixty-nine fifth- and sixth-grade students served as Ss. They were obtained from four middle-class Roman Catholic elementary schools, three of which were in a midwestern city of 170,000 population and the fourth in a small town immediately adjoining this city. All Ss were white. Sex distribution was approximately equal, with 139 girls and 130 boys. The mean age was 11.17 years (S.D. = 0.72) with a range of 10-13 years.

Materials

The passage to be learned was concerned with the elements of a basic sentence as described by Thomas (1965). It was 464 words long, with 48 sentences. Readability of the passage was mid- to upper-third grade using the Fry Readability Scale (Fry, 1968) and fifth- to sixth-grade level using the Dale-Chall Formula (Dale & Chall, 1948).

Along with the control passage, three further versions were generated by randomizing one-third, two-thirds, or all of the sentences. This is the same procedure as that used by Farley (in preparation [a]) in the prior study. The procedure consisted of randomly selecting the number of sentences for each version of the passage, e.g., 16 for the one-third version, and randomly reassigning each of these sentences to one of the passage locations which the withdrawn sentences originally occupied. In the completely randomized condition, the locations of all 48 sentences were randomly interchanged.

An advance organizer, written to give a general outline of the passage without providing specific information, was constructed in a similar manner to those discussed by Ausubel (1968). The advance organizer was 92 words long and consisted of nine sentences. Only one example of the advance organizer was prepared, as all Ss received the same version.

Presentation of the passages was auditory; accordingly, each of the four versions of the passage was taped on a Sony Model TC-60 cassette tape recorder using Sony Model C-60 cassette tapes. One passage was recorded on each side of two such tapes. Each passage was preceded by the advance organizer, with the same organizer for each passage. The organizer and passages were recorded by a female professional television and radio announcer and interviewer. The playing time was 46.25 seconds for the advance organizer and 244.50 seconds for each of the passages.

The retention test was a 12-item measure of literal and inferential comprehension of the passage. Each item was a four-alternative multiple-choice type, with six of the items reflecting literal and six inferential comprehension. Construction of the items followed procedures recommended by Bormuth (1970). A retention test booklet was employed consisting of 13 pages with one item per page and a cover or face-sheet. On each test-item page, the following instructions were presented at the top and bottom, respectively, of the page: "Read the question carefully and put a circle around the correct answer," and "Go on to the next page. Do not turn back to previous pages." Approximately 450 such 13-page booklets were constructed with 30 different random orders of the 12 test items. The cover sheet requested such data as name, age, sex, grade, teacher, and school. The use of such a booklet with single-item pages and the requirement that S not turn back to previous pages was used as an improvement over the previous study (Farley, in preparation [a]) which presented random orders of the items on regular 8-1/2 x 11 inch sheets, thus allowing for the possibility of S employing cues from one item in responding to another.

For those Ss who were not given the short-term retention test, but only the long-term test one week later, a "filler" booklet was used that took an equivalent time to complete as the

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retention test itself. Thus, while short-term retention test Ss were completing the retention test, the Ss assigned to the long-term retention condition worked in the filler booklet. This booklet was identical in appearance and number of pages to the test booklet, and included the same cover page. The following instructions were presented at the top and bottom, respectively, of each of the 12 pages: "Please fill this page in with X's and O's," and "When you have finished filling up the page with X's and O's, turn to the next page. Do not turn back to previous pages." The use of such a filler task was based on previous research (Farley & Schmuller, 1972) and was chosen to simulate the testing conditions of the short-term retention test yet not to reinforce any of the information from the passage which could have affected the later long-term retention test.

Procedure

A 4 x 2 x 2 design was employed consisting of the control passage plus the three variations, two retention intervals, and two types of comprehension items (fact versus inference). The last factor was a repeated measure in that all Ss received both the fact and inference items. The retention intervals were immediate and seven days. This design replicated that of Farley (in preparation [a]). Ss were randomly assigned prior to testing to one of the four passage conditions which consisted of the advance organizer and one version of the passage. Passage presentation and retention testing were done in small groups. Immediately upon completion of the passage, short- and long-term booklets were distributed randomly in equal numbers to the Ss in a given group.

The two testing sessions, short- and long-term, were separated by exactly seven days, with the long-term test being given at the same time of day and in the same room as the short-term test. All Ss in the experiment were given the long-term test, including those who were given the short-term measure.

Testing conditions (e.g., room size, etc.) in each of the four schools were comparable.

At the beginning of the first testing session the Ss each had a typed copy of the advance organizer face down on their desks. The E instructed them to turn the copy over and read along with the tape recording. The Ss were not told that a comprehension test would be administered. At the end of the organizer, Ss were told to turn the papers face down again, and these were collected by E. The temporal interval between the end of the advance organizer and the beginning of the passage was 60 seconds. No printed copy of the passage itself was given to the Ss. Immediately following presentation of the passage, the test and filler booklets were distributed. The Ss were told by E to ignore the cover page and go directly to page one, and to read the instructions on each page carefully and "do what they say." As Ss completed the booklets, E individually instructed them to fill out the cover page. When all of the tested Ss in the group had finished the questions, those with the filler booklets were asked to stop where they were and complete the cover page. Booklets were not collected and no group instructions were given until a standardized 10 minutes had elapsed. All timing was covert and standardized. The same tape recorder was used at the same volume and tone settings and room location for each group.

For the long-term test session seven days later, the test booklets were distributed to all Ss, and the same standardized instructions as in the first session were used. Again, the cover page was completed only after the test items had been administered. The same E was used for both the short- and long-term sessions. The order of test items for each S was random within passage conditions, but the orders for a given passage condition were duplicated in the remaining passage conditions. For those Ss who completed both short- and long-term tests, the order of items on the long-term test was random with respect to the order on the short-term test. Again, however, these orders were duplicated across but not within the passage conditions.

The Ss were not told prior to distribution of the test booklets that they were to be tested, and they were not informed in advance of the seven-day retention test. Following the short-term session, they were asked not to talk about the passage or the test to others. Following completion of the whole experiment, the study was explained to students and teachers.

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III
Results

The mean literal and inferential comprehension scores and standard deviations for the various conditions of the experiment are given in Table 1.

The data summarized in Table 1 were subjected to multivariate and univariate analyses of variance. The results of these analyses are summarized in Table 2.

From Table 2 it can be seen that the only significant effects are those associated with retention interval and comprehension type. The retention interval main effect suggests that forgetting occurred over the seven-day period. The significant retention interval by comprehension type interaction suggests that there was differential forgetting between the literal and inferential item types; that is, there may be less retention loss for one type of item compared to the other. In order to determine the direction of this interaction, the mean percent retention of literal and inferential items on the short- and long-term tests was computed collapsed across all other conditions of the experiment. These results are summarized in Figure 1.

From Figure 1 it can be seen that greater forgetting of literal over inferential comprehension items occurred in long-term retention. The mean percent memory loss in the former group was 11% compared to 3% in the latter condition.

TABLE 1
MEAN COMPREHENSION SCORES AND STANDARD DEVIATIONS FOR THE VARIOUS GROUPS AT TWO RETENTION INTERVALS

	Retention Interval								
	Short-Term					Long-Term			
	Literal Comprehension			Inferential Comprehension		Literal Comprehension			Inferential Comprehension
Passage Condition	N	Mean	SD	Mean	SD	N	Mean	SD	Mean	SD
Control Passage	32	4.063	1.625	4.938	1.243	32	3.125	1.070	4.250	1.320
One-third Randomization	32	4.094	1.353	4.594	1.214	35	2.943	1.083	4.229	1.497
Two-thirds Randomization	33	3.636	1.141	4.242	1.582	35	3.286	1.073	4.600	1.479
Complete Randomization	33	3.636	0.994	4.758	1.226	36	3.250	1.180	4.639	1.417

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TABLE 2
SUMMARY OF ANALYSIS OF VARIANCE OF COMPREHENSION SCORES AS A FUNCTION OF PASSAGE STRUCTURE AND RETENTION INTERVAL

Source	df (numerator)	df for Multivariate Test	Significance Levels: Multivariate Test	Significance Levels: Within Comprehension Type: Lack of Uniformity	Significance Levels: Within Comprehension Type: Sum
Mean	1			.0001	
Between Subjects	267				
Between Conditions	7				
Passage Structure	2	6/518	.749		
Retention Interval	1	2/259	.0001	.0026	.0011
Retention x Passage Structure	2	6/518	.197		
Between Ss Within Conditions (Error)	260	MS=		1.829	4.876

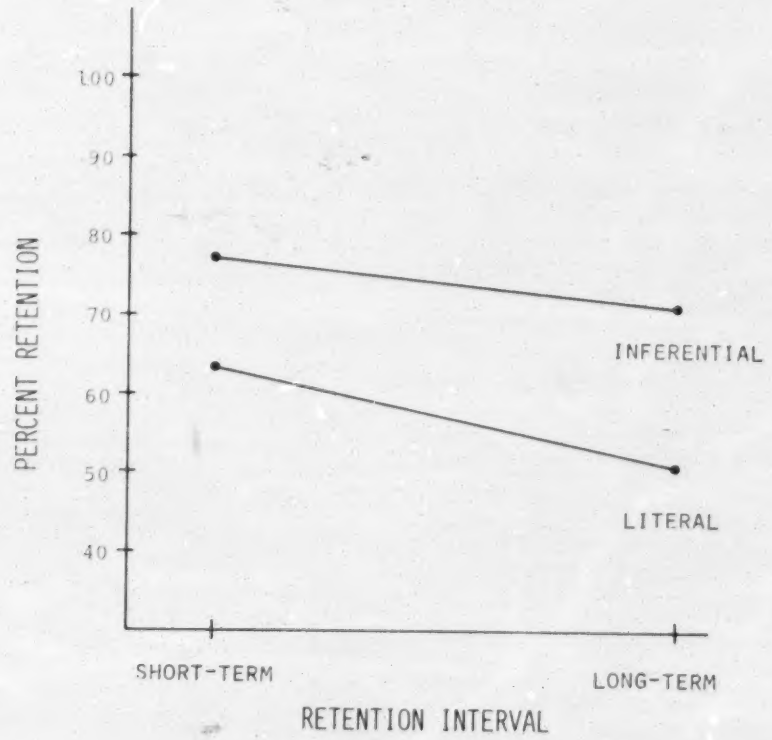

Figure 1. Mean percent retention of literal and inferential comprehension items on short- and long-term retention tests.

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IV
Discussion

It is clear from the present results that no effect of passage randomization was obtained on either short- or long-term retention or literal versus inferential comprehension. This study employed a more logically organized passage than that previously used by Farley (in preparation [a]), and increased the memory load requirements over his study, with the results in essential agreement with his findings of no effects either of passage organization or presence or absence of the advance organizer. The results of the two studies taken together suggest that uncertainty-manipulated arousal may not be effective in influencing comprehension, at least using the general paradigm of these experiments. It is, however, of great interest that random versus organized passage structure had no significant effect on comprehension. This replicated finding is clearly worthy of further systematic investigation.

The lack of significant memory loss for inferential comprehension over seven days, compared to the significant loss for literal comprehension, is of great interest and is in line with Farley's earlier data. This interaction of comprehension type and retention interval should be further investigated in studies aimed specifically at identifying differences between literal and inferential processing of prose.

Clearly, where the facilitation of children's learning and comprehension of prose is concerned, one conclusion applies--further research is needed. The present study is offered as one contribution to that program.

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